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|  Eskom | Standard | Technology |
|--|-----------------|-------------------|

Title: **LV POWER AND CONTROL
CABLE WITH RATED VOLTAGE
STANDARD 600/1000V**

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Compiled by



Queeneth Khumalo

**Chief Engineer – Dx Ops
Support**

Date: 09 June 2022

Approved by



Jacques Paulse

**Convener - MV&LV Cable
Systems CG**

Date: 09 June 2022

Authorized by



Mfundi Songo

**Senior Manager- Dx
Engineering**

Date: 9 June 2022

Supported by SCOT/SC



Queeneth Khumalo

Chairperson - CS&MES SC

Date: 09 June 2022

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1. Introduction

This Eskom Specification is based on the requirements of NRS 074-1 Edition 2.

Compulsory safety specification VC 8075 stipulates that all low voltage cables in South Africa shall comply with the requirements of SANS 1507.

Where any conflicting requirements exist, this document will take precedence.

2. Supporting clauses

2.1 Scope

This specification covers Eskom's requirements for LV power and control cables in accordance with SANS 1507-1 and SANS 1507-3.

2.1.1 Purpose

The purpose of this specification is to specify the technical requirements for LV power and control cables to be supplied to Eskom.

2.1.2 Applicability

This document shall apply throughout all Eskom Holdings Limited Divisions.

2.2 Normative/informative references

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

- [1] ISO 9001, Quality Management Systems.
- [2] 240-560360637, General information and requirements for low-voltage cable systems.
- [3] 240-56227443, Requirements for control and power cables for power stations.
- [4] SANS 1507, Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V).
- [5] VC 8075, Compulsory specification for the safety of electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V).
- [6] NS 074-1, Low-voltage (600/1 000 V) cable systems for underground electrical distribution.
- [7] D-DT 3128, Buyer's guide for LV power and control cables.
- [8] D-DT 0856, Standard power and control cable codes.
- [9] D-DT 3248, Buyer's guide for LV CCAA cables.
- [10] 0.00/1310, Standard power and control cable codes for Generation application.

2.2.2 Informative

None

2.3 Definitions

2.3.1 General

The definitions in SANS 1507 and NRS 000 shall apply.

2.3.2 Disclosure classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.4 Abbreviations

The abbreviations in SANS 1507, NRS 000 and the following shall apply.

| Abbreviation | Description |
|--------------|---|
| Al | Aluminium |
| CCAA | Copper Cladded Aluminium Alloy |
| Cu | Copper |
| LV | Low Voltage |
| NRS | National Rationalised Standards |
| PVC | Polyvinyl Chloride |
| QMS | Quality Management System |
| SANAS | South African National Accreditation System |
| SANS | South African National Standards |
| UV | Ultraviolet |

2.5 Roles and responsibilities

All Eskom employees and/or appointed bodies involved in the procurement of LV power and control cables shall ensure that these products meets the requirements as specified in this document.

Note: Any deviation from these requirements shall constitute non-conformance.

2.6 Process for monitoring

The LV power and control cables acceptance shall be based on the relevant technical evaluation criteria at the time of tender and based on factory acceptance testing requirements as per this standard.

2.7 Related/supporting documents

Refer to clause/ section 2.2.

3. Requirements

3.1 Rated voltage

The rated voltage of the cable shall be 600/1000 V.

3.2 Materials and construction

3.2.1 Conductors

- a) The conductors for power cables shall be either stranded copper or stranded aluminium. The conductor type and size required will be specified in schedule A.
- b) The conductor for multi-core control cables shall be stranded copper. The conductor size required will be specified in schedule A.
- c) Options for CCAA or aluminium alloy conductors will be allowed for LV service cables as well as multi-core control LV cables for pilot or trial projects of new conductor types. The conductor size required will be specified in schedule A.

3.2.2 Insulation

The cables shall be PVC insulated.

3.2.3 Number of cores and core identification

- a) The number of cores required will be specified in schedule A.
- b) Core identification of power cables shall be as indicated in table 1:

Table 1: Core identification

| Number of phase cores | Colour(s) of phase cores | Colour of neutral core |
|-----------------------|---|-----------------------------|
| 1 | Red, or yellow or blue | Black |
| 2 | Red and yellow | Black |
| 3 | Red, yellow and blue | Black |
| 4 or more | Any base colour except green, with serial numbers (numerals or words) | Numbered as for phase cores |

- c) Core identification of control cables (i.e. with more than four cores) shall be by means of numbering.

3.2.4 Bedding under armouring

The cables shall have PVC bedding.

3.2.5 Armour

- a) Single-core cables shall have aluminium wire armour, unless otherwise specified in schedule A.
- b) Multi-core cables shall have galvanized steel wire armour.

3.2.6 Outer sheath

- a) The cables shall have PVC outer sheathing.
- b) The outer sheath shall be ultraviolet (UV) radiation stabilised.

3.2.7 Fire performance requirements

The cables shall be flame retardant (red stripe) unless otherwise specified in schedule A. Where required, the cable shall have a reduced halogen (blue stripe) or zero halogen (white stripe) emission property.

The use of cables having a reduced halogen (blue stripe) or zero halogen (white stripe) property are normally restricted to Generation applications only.

3.3 Packaging and marking and labelling

Marking labelling and packaging shall be in accordance with SANS 1507 and this specification.

3.3.1 Packaging

- a) The wooden drums shall be resistant to biological attack and therefore be treated in accordance with the relevant SANS 10005 standard. The supplier shall ensure that the treatment method used to treat the drums is not harmful to the environment and human beings.
- b) Unless otherwise specified in schedule A, cables shall be supplied in the following drums lengths:
 - 1) Cables having conductor sizes up to and including 16 mm²: drum lengths of 500 m; and
 - 2) Cables having conductor sizes larger than 16 mm²: drum lengths of 300 m.

3.3.2 Marking of conductor

- a) Each individual conductor shall be marked with a unique and traceable identification system.

Note: The purpose of marking the conductors is to ensure proof of ownership through traceability of the conductor using the identification system.

- b) The manufacturer shall keep a secure database of all uniquely marked conductors supplied to Eskom.
- c) The conductor identification system shall comply with the following minimum requirements:
 - 1) The identification system shall be durable and withstand the expected conditions during the manufacturing processes and operating conditions of the cable over its life. If requested, sufficient proof shall be provided that the identification system offered is chemically compatible with the various materials it may be in contact with inside the cable,
 - 2) The identification system shall withstand, without melting or other deleterious effects, continuous conductor operating temperatures of 90°C and short-circuit conductor temperatures of at least 250°C,
 - 3) The identification system shall not negatively impact the electrical and mechanical integrity and performance of the cable over its expected life,
 - 4) The identification system shall not negatively impact the environment in which the cable is installed over its expected life,
 - 5) The identification code shall consist of any of the following options:
 - Alpha-numeric or alpha or numeric characters,
 - Eskom name,
 - Eskom logo,
 - Coloured yarn,
 - Marks, or
 - Groove.
 - 6) The identification system used shall be visible to the naked eye so as to readily identify that the conductor is marked,
 - 7) The identification code shall be marked (i.e. appear) at intervals not exceeding 500 mm if not continuous in nature,

-
- 8) Where applicable the characters used to uniquely identify the conductor shall be legible with the naked eye or, at most, with the assistance of a portable hand-held magnifying glass. The font size offered and, if applicable, the magnification factor required to read the characters shall be stated in schedule B, and
- 9) Where applicable for alpha-numeric characters the algorithm used to generate the identification code shall be unique for each manufacturer.
- d) Details of the proposed conductor identification system shall be submitted with the tender documentation. The system shall be subject to approval by Eskom.

3.3.3 Unique marking of cable

Proposal and method for marking of cable shall be submitted to Eskom for evaluation. The cable marking method shall be installed between the cable insulation and the cable outer sheath. The proposed method for marking shall meet the following requirements.

- a) Cable shall be marked with a unique and traceable identification system. The cable identification system location shall be stated in schedule B.

Note: The purpose is to provide asset management information relating to the cable manufacturer, order number, date of manufacture, drum number, conductor identification code range, etc.

- b) The manufacturer shall keep a secure database of all uniquely marked cables supplied to Eskom.
- c) The cable identification system shall comply with the following minimum requirements:
- 1) The identification system shall be durable and withstand the expected conditions during the manufacturing processes and operating conditions of the cable over its life. If requested, sufficient proof shall be provided that the identification system offered is chemically compatible with the various materials it may be in contact with inside the cable,
 - 2) The identification system shall withstand, without melting or other deleterious effects, continuous conductor operating temperatures of 90°C and short-circuit conductor temperature of at least 250°C,
 - 3) The identification system shall not negatively impact the electrical, mechanical integrity and performance of the cable over its expected life,
 - 4) The identification system shall not negatively impact the environment in which the cable is installed over its expected life,
 - 5) The identification code shall consist of any of the following:
 - Alpha-numeric, alpha or numeric characters,
 - Eskom name,
 - Eskom logo,
 - Coloured yarn,
 - Indented marks, or
 - Groove,
 - 6) The identification system used shall be visible to the naked eye so as to readily identify that the cable is marked,
 - 7) The identification code shall be marked (i.e. appear) at intervals not exceeding 500 mm if not continuous in nature,

Note: The identification code will therefore be repeated for up to a maximum distance of one meter of cable.

- 8) The characters used to uniquely identify the conductor shall be legible with the naked eye without the need for any magnification. The font size offered shall be stated in schedule B, and

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-
- 9) The algorithm used to generate the identification code shall be unique for each manufacturer.
- d) Details of the proposed cable identification system shall be submitted with the tender documentation. The system shall be subject to approval by Eskom.

3.3.4 Marking of cable outer sheath

- a) Cables shall be legibly marked in accordance with the requirements of SANS 1507, but the marking shall include the specification number to which the cable has been manufactured, the year of manufacture, rated voltage, the conductor size in mm², the number of cores, the conductor material e.g. Cu (Copper) and the word "ESKOM". A typical legend would be:
- "XXXXXXXXX CABLES 2017 600/1000 V 70 mm² 4C Cu SANS 1507 ESKOM"
- b) The cables shall bear the mark of a SANAS accredited product certification body marking scheme.
- c) The gap between the end of one legend and the beginning of the next shall not exceed 275 mm.
- d) The cable shall be sequentially marked at one metre intervals with the legend 000 m, 001 m etc. starting with 000 m at the barrel of the drum and finishing with the number indicating the length of cable on the drum at the outer end of the cable. The error in the length marking shall be less than 1 %,
- e) Cables shall have a colour coded stripe in accordance with SANS 1507.

3.3.5 Marking of cable drums

- a) In addition to the requirements of SANS 1507, cable drums shall be clearly and indelibly marked with the Eskom stock (SAP) number (i.e. "Eskom SAP Number: XXXXXXXX").
- b) All LV power and control cables drums destined for Eskom shall be branded with the Eskom logo on one of its flat sides (the flange). The Eskom logo shall be printed in Eskom blue or black on a white-coloured background.
- c) For metal or wooden drums, a portion of the flange surface shall be painted in white to provide a rectangular background on which the signature shall be printed. The height of the white rectangular background shall be three times the diameter of the "circle" part of the Eskom logo.
- d) The printed Eskom logo shall appear centrally on the white rectangular background leaving a space equal to at least one logo "circle" before and after the Eskom logo.
- e) The Eskom logo printing shall be made using a stencil technique or other equivalent techniques which shall be demonstrated to and approved by Eskom. The dimensions of Eskom logo shall be a minimum length and height of 820 mm and 210 mm respectively. The Eskom logo and standard requirements are shown in Annex A.

All other printing on the flange shall be positioned so as to ensure a minimum clearance of one logo circle ("circle") diameter away from the Eskom logo.

The cable drum shall have a label/ or nameplate. The label or name plate shall be UV stable and water resistant. The name plate shall have the following information:

- SAP number,
- Order number,
- Batch number, and
- Technical information of the cable (i.e: manufacturer's name, cable size, number of cores, voltage, insulation material, applicable standard to which the cable was manufactured, drum weight armouring, etc.).

3.4 Documentation

A catalogue that gives the following information shall be provided at the time of tender for the full range of cables manufactured in accordance with SANS 1507:

3.4.1 Cable dimensional data:

- a) Diameter over conductor,
- b) Diameter over insulation,
- c) Diameter over bedding,
- d) Diameter over armour wires (if applicable)
- e) Diameter over the outer sheath, and
- f) Insulation thickness around conductor.

3.4.2 Cable rating information

- a) Maximum sustained current rating in:
 - 1) Ground,
 - 2) Air, and
 - 3) Ducts.

Note: The standard installation conditions assumed shall be stated.

- b) Short-circuit ratings,
- c) Cable mass (kg/m),
- d) Gross mass per standard drum length (kg),
- e) The 50 Hz a.c. resistance at maximum sustained conductor operating temperature (ohm/km),
- f) Reactance per phase (ohm/km),
- g) Capacitance per phase (nF/km), and
- h) Zero sequence impedance and capacitance per phase at maximum sustained conductor operating temperature (ohm/km).

Note: The sequence impedances need only be provided for the range of cables required with an enquiry.

3.4.3 Technical schedules and test schedules

The full Technical Schedules B (including the Test Schedules and the Deviation Schedules) shall be completed and submitted to Eskom together with the Technical Schedules A for approval at the time of tendering.

3.4.4 Test reports

All required type, routine and sample test reports (complete test reports, including the reference to all tested materials used in the cable construction) shall be submitted to Eskom, in English, by the manufacturer at the time of tendering and/ or pre-qualification. The cable shall be tested in accordance with SANS 1507.

All cables offered shall carry valid product type tests reports in accordance with SANS 1507-3, and manufactured cables shall carry the SANAS accredited product certification body mark scheme. A copy of all relevant type test reports and the required tender returnable documentation shall be submitted at the time of tender enquiry submissions. Mark scheme permit and accompanying schedules shall also be submitted for all type tested cables.

Note: Verification of the certification body will have to be performed on the SANAS website www.sanas.co.za

3.5 Quality management system

- a) The supplier (deemed to be an organization that undertakes any manufacturing or assembly operation) shall have a formally documented and implemented quality management system (QMS), which as a minimum meets with the requirements of the international code of practice for quality systems ISO 9002. Eskom reserves the right to audit quality management systems for suitability, effectiveness and to verify all goods for conformance prior to delivery.
- b) Additional quality requirements may apply when Eskom enters into a term contract. Specific requirements will be specified therein.

4. Authorization

This document has been seen and accepted by:

| Name and surname | Designation |
|----------------------|--|
| Mfundu Songo | Senior Manager: Engineering |
| Azwimbavhi Mamanyuha | General Manager: Dx Operations Support |
| Jacques Paulse | Convener: MV/LV Cable Systems CG |

5. Revisions

| Date | Rev | Compiler | Clause | Remarks |
|------------|-----|------------|--------|---|
| Nov 2022 | 3 | Q Khumalo | | Document revision cycle. |
| | | | 3.4.4 | SANAS accredited product certification body mark scheme has been added. |
| Nov 2017 | 2 | D Monyane | | Revised to align with the latest template. This document replaces ESP 32-1272. |
| | | | 3.2.1 | Added copper clad aluminium conductor and aluminium alloy conductors as an option for control cables. |
| | | | 3.4 | Marking of conductor edited to include other methods of marking. |
| | | | 3.5 | Marking of cable edited to include other methods of marking. |
| May 2013 | 1 | B Mwarehwa | | Final Document for Publication. |
| March 2011 | 0 | B Mwarehwa | | Draft Document for review created from 34-1622. |

6. Development team

The following people were involved in the development of this document:

- B. Olivier: SI WCOU (Senior Technician)
- D. Monyane: Gx (Chief Technologist)
- J. Mahlangu: SI LOU (Senior Technician)
- J. Paulse: SI WCOU (Senior Engineer)
- M. Mathonsi: SI LOU (Senior Engineer)

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- N. Booyens: SI KZN (Senior Engineer)
- Q. Khumalo: Dx Ops Support HV Plant (Chief Engineer)
- S. Mtshaulana: SI GOU (Engineer)
- T. Phali: SI ECOU (Senior Technician)

7. Acknowledgements

Not applicable.

Annex A – Eskom Logo: Printing Guide And Format

1) The Eskom logo printing guide and format

The logo circle ("circle") and the logo word (the word "Eskom") shall always appear together as one unit.

Colour specifications

The Eskom logo shall appear in the Eskom corporate blue or in black. The Eskom corporate blue is as follows:

- Pantone 287C
- 100%C + 70%M + 0%Y + 10%K

Relationship between the logo circle ("circle") and the logo word (the word "Eskom")

The relationship between the logo circle ("circle") and the logo word (the word "Eskom") shall always be followed as indicated in the graphic. The measurement between the logo circle ("circle") and the logo word (the word "Eskom") is twice the line-width of the "circle".

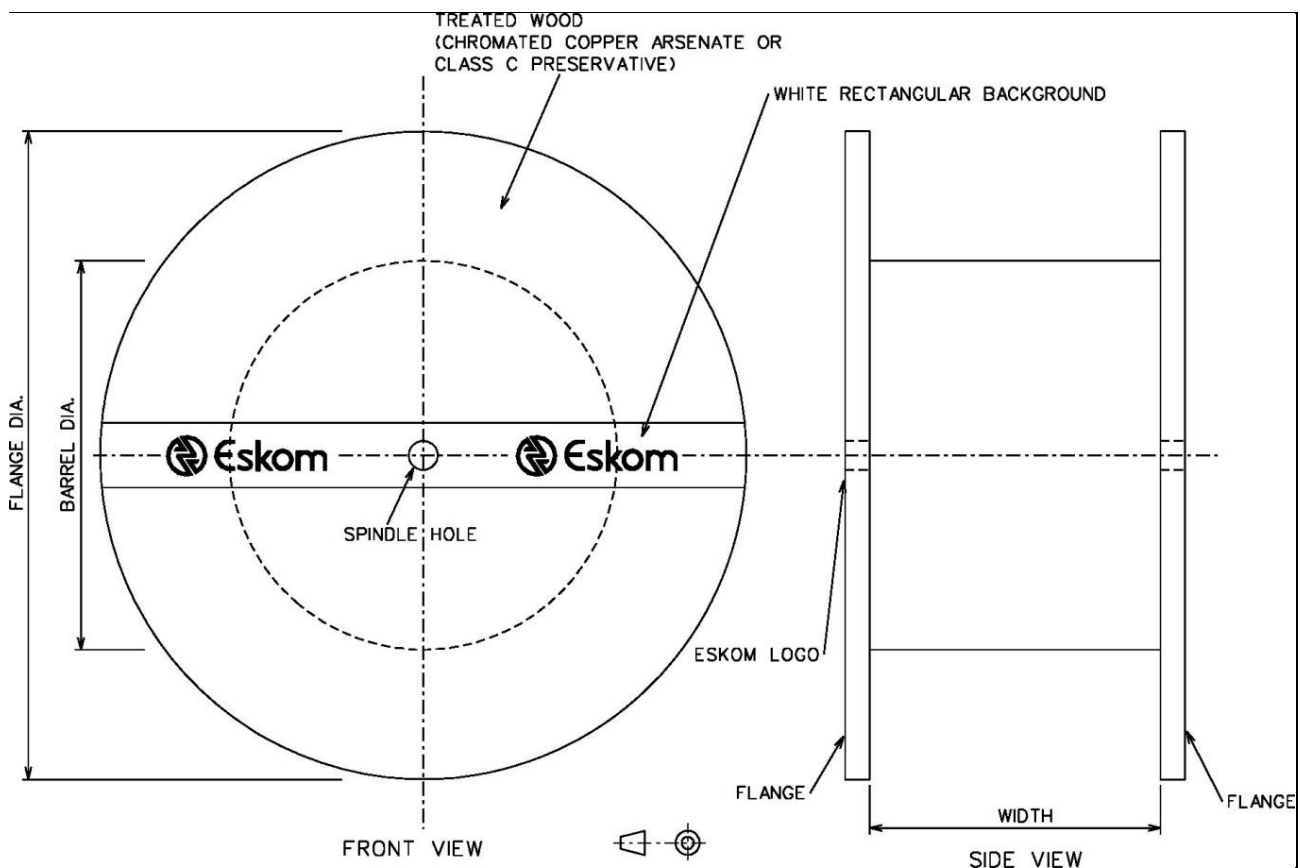


Figure A.1: Typical wooden drum showing Eskom logo branded flange



Figure A.2: The Eskom logo format

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Annex B – Technical Schedule A & B for LV POWER AND CONTROL CABLE

Informative

Use of the technical schedules is intended to obviate the need for preparing a detailed technical specification for every enquiry. The purchaser need only specify compliance with 240-56063805 and provide the tenderers with the relevant schedules A and B.

Schedule A gives Eskom's requirements. It lists the requirements to be specified by the purchaser in enquiries and orders. These requirements may include references to the relevant sub-clauses in this document. Where the text of any referenced standard stipulates that the purchaser shall indicate his requirements, these requirements should also be specified in schedule A. The purchaser shall set out his particular requirements and choices in schedule A.

The purchaser shall require the tenderer to fill in schedule B. By doing this, the tenderer will state compliance with this document and provide the information the purchaser has requested. Schedule B shall be completed in full by the tenderer.

If a blank space is left in schedule B next to a certain requirement specified in schedule A, this constitutes as a confirmation that the tenderer does not comply with that specific requirement.

Deviations/modifications/alterations from the requirements specified in Schedule A shall be well documented in the deviation schedule.

Price schedules shall be so drawn up and the covering letter so worded that the costs of all services such as tests and delivery are declared and allowed for in the tender.

| TECHNICAL SCHEDULES A & B FOR LV CABLES | | | | | |
|---|------------------------|--|-----|------------|------------|
| Schedule A: Purchasers specific requirements | | | | | |
| Schedule B: Guarantees and technical particulars of equipment offered | | | | | |
| Item | Clause in 240-56063805 | Description | | Schedule A | Schedule B |
| 1 | | Item and system description | | | |
| | | LV PVC Cable | | | |
| 1.1 | | SAP No | | | xxxxxxxxxx |
| 1.2 | | Buyers Guide Drawing | | D-DT-3128 | xxxxxxxxxx |
| 1.3 | | Symmetrical fault level rating | kA | xxxxxxxxxx | _____ |
| 1.4 | 3.1 | Nominal system voltage | V | 1000 | _____ |
| 1.5 | | Earth fault level rating | kA | xxxxxxx | _____ |
| 2.1 | 3.1 | Rated voltage (U_r) | V | 1000 | _____ |
| | 3.2.2 | Insulation material | | PVC | _____ |
| | 3.2.1 | Conductor material | | Cu or Al | _____ |
| | 3.2.1 | Conductor Size | | _____ | _____ |
| 2.3 | 3.2.3 | Number of cores | | _____ | _____ |
| | 3.2.3 | Are colours of phases as per clause 4.2.3? | | Yes | _____ |
| | 3.2.4 | Bedding under armouring | | PVC | _____ |
| 2.9 | 3.2.5 | Armour | | _____ | _____ |
| 2.10 | 3.2.6 | The cable shall have PCV outer sheathing, and shall be UV radiation stabilized. | | Yes | _____ |
| 2.11 | 3.2.7 | Does the cable meet the fire performance requirements as per 3.2.7? | | _____ | _____ |
| 2.13 | SANS 1507-3 5.2.2 | Rated frequency (f_r) | Hz | 50 | _____ |
| 3.1 | 3.3.5 | Does the supplied wooden drum meet the minimum requirements as per clause 3.3.5? | | Yes | _____ |
| 3.2 | 3.3.1 b) | Drum length required if other than that specified in 3.3.1? | m | _____ | _____ |
| 3.3 | 3.3.2 | Is conductor marking system details supplied with tender? | | Yes | _____ |
| 3.4 | 3.3.2 c)8) | Font size for conductor marking characters | mm | xxxxxxxxxx | _____ |
| 3.5 | 3.3.3 | Is the unique marking of cable identification system details supplied with tender? | Yes | Yes | _____ |
| 3.6 | 3.3.3 a) | Cable identification system location? | | xxxxxxxxxx | _____ |
| 3.7 | 3.3.3 c)8) | Font size for the cable identification system characters | mm | xxxxxxxxxx | _____ |
| 3.8 | 3.3.4 | Does the marking of cable outer sheath comply to 3.3.4? | | Yes | _____ |
| 3.9 | 3.4 | Are all relevant documents submitted? | | Yes | _____ |

| | | | | | |
|-------------------|----------|--|------|-------------|-------|
| 3.10 | 3.4 | Is catalogue provided with tender documentation? | | Yes | _____ |
| 3.11 | 3.4.4 | Copy of type tests report and where applicable certificates to be provided with tender documentation | | Yes | _____ |
| 3.12 | 3.4.1 | Dimensions of cable submitted | | Yes | _____ |
| 3.13 | 3.4.2 a) | Maximum sustained current rating in: | | | |
| 3.14 | 3.4.2 a) | Ground? | A | xxxxxxxxxxx | _____ |
| | | Air? | A | xxxxxxxxxxx | _____ |
| | | Ducts? | A | xxxxxxxxxxx | _____ |
| 3.15 | 3.4.2 b) | Short circuit rating? | kA | xxxxxxxxxxx | _____ |
| 3.16 | 3.4.2 c) | Cable mass? | kg/m | xxxxxxxxxxx | _____ |
| 3.17 | 3.4.2 d) | Gross mass per standard drum length? | kg | xxxxxxxxxxx | _____ |
| 3.18 | 3.4.2 e) | Resistance at max conductor temperature? | °C | xxxxxxxxxxx | _____ |
| 3.19 | 3.4.2 f) | Reactance per phase? | Ω/m | xxxxxxxxxxx | _____ |
| 3.20 | 3.4.2 g) | Capacitance per phase? | nF/m | xxxxxxxxxxx | _____ |
| 3.21 | 3.4.2 h) | Zero sequence impedance and capacitance per phase? | Ω/m | xxxxxxxxxxx | _____ |
| 3.22 | 6 | Testing of cable is done in accordance with SANS 1507-3? | | Yes | _____ |
| SIGNATURES | | | | | |
| | | | | | |
| Supplier | | Name (Print) | | Sign | Date |
| | | | | | |
| Factory | | Name (Print) | | Sign | Date |
| | | | | | |
| Eskom | | Name (Print) | | Sign | Date |

Document Classification: Controlled Disclosure

**LV POWER AND CONTROL CABLE WITH RATED
VOLTAGE STANDARD 600/1000V**

Unique Identifier: **240-56063805**

Revision: **3**

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